QUANTOXOCRINUS, A NEW DEVONIAN INADUNATE CRINOID FROM WEST SOMERSET, ENGLAND

by B. D. WEBBY

ABSTRACT. *Quantoxocrinus ussheri* gen. et sp. nov. is described from the upper part of the Ilfracombe Beds (Upper Givetian or Lower Frasnian) in the Quantock Hills, west Somerset, and the palaeoecological significance of its occurrence is discussed.

DURING recent geological studies in the Quantock Hills, numerous external moulds of a small, delicate crinoid were found in a thin brownish-grey, weathered (originally calcareous) siltstone. The crinoid bed, only 6 inches thick, and seemingly underlain and overlain by unfossiliferous siltstones and sandstones, is exposed beside a forestry track in Wind Down Plantation (National Grid Ref. ST221339). Much of the material is too poorly preserved for detailed study, but a limited number of good specimens were extracted, and form the basis of the present paper.

This new inadunate crinoid occurs stratigraphically towards the middle of the Leighland Beds, in the upper part of the Ilfracombe Beds, and lies near, probably just below, the Givetian–Frasnian boundary. A similar inadunate, *Decadocrinus oaktrovensis*, has previously been described from the lower part of the Ilfracombe Beds of west Somerset, in the Oaktrow Sandstone of probable Middle Givetian age (Webby 1962, 1964).

The Ilfracombe Beds of west Somerset are a thick, argillaceous and arenaceous succession, containing several important developments of limestone at different horizons. These limestones are composed of abundant crinoidal fragments, mostly disarticulated columnals (it is unusual to find articulated columnals). Evidence from the crinoidal remains suggests that the bulk of these limestones accumulated in a shallow-water environment subjected to strong wave or current action. Scattered, disarticulated columnals are found on bedding planes at irregular intervals throughout the rest of the Ilfracombe succession, and these occurrences similarly suggest moderate to strong action. However, at two localities, one in the Oaktrow Sandstone of the Brendon Hills, and the other in the Leighland Beds of the Quantocks, small, fragile, complete and partly complete crinoids occur abundantly within a single thin bed of siltstone. In the Oaktrow occurrence, the crinoids are mainly randomly distributed through the siltstone, with broken crown and stem fragments associated with the more complete specimens. The crowns of many of these crinoids have parted from their stems, but have otherwise remained intact. The crinoid occurrence in the Quantocks bears many similarities to that of Oaktrow, but there is a slightly stronger alignment of specimens, and a tendency for crowns and, more especially, stems to lie on bedding planes. Also, a greater proportion of stems to crowns seem to be preserved. These gregarious and delicate crinoids bear cirri, suggesting that they were anchored in the muddy silt of the sea bed. They either established themselves on the sea floor during a period of reduced sedimentation and very gentle current action or, alternatively, they colonized a shallow depression on the sea floor, presumably protected from the stronger currents (Laudon 1957, p. 963).

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Apparently, after a comparatively short period of occupation, the crinoids were overwhelmed suddenly by a stronger, sediment-laden current. The Oaktrow fauna was probably buried more or less where it was overwhelmed, whilst the Quantock fauna, with its crude alignment of specimens and disarticulation of stems from crowns, was perhaps transported a short distance by the current. The greater proportion of stems to crowns in the Quantock fauna may be the result of the break up of the more fragile crowns during entombment or, perhaps, the crowns detached themselves from their stems and floated away in the stronger currents preceding the entombment.

SYSTEMATIC DESCRIPTION

The numbers of specimens in the Geology Department collection, University of Bristol, have the prefix BU.

Subclass INADUNATA Wachsmuth and Springer
Order CLADOIDEA Moore and Laudon
Suborder DENDROCRINOIDEA Bather
Genus QUANTOXOCRINUS gen. nov.

Type species. Q. ussheri sp. nov.

Diagnosis. Small, slender, ten-armed dendrocrinoid, having prominent infrabasals; three anal plates in the dorsal cup, the radianal similar in size, or slightly larger than anal X, and a large anal sac, plicated distally; arms branching isotomously on the fourth or fifth primibrach, and bearing pinnules; stem, proximally, composed of pentagonal columnals; distally, round columnals with crenulate sutures, and cirri.

Discussion. The genus bears similarities to a number of dendrocrinoid genera, including *Iteacrinus* Goldring, *Decadocrinus* Wachsmuth and Springer, *Denariocrinus* Schmidt, and *Rhadinocrinus* Jaekel. *Iteacrinus* (type species *I. flagellum*) exhibits the closest resemblance, but differs in having heterotomous branching, with ten main rami bearing long, slender, unforked ramules at regular intervals alternately on each side (Goldring 1923, p. 344). Devonian species of *Decadocrinus* differ in exhibiting isotomous branching on the second primibrach and, judging from *D. oaktrovensis*, rounded columnals with smooth articular faces in the distal part of the stem. *Denariocrinus* (type species *D. ferula*) also shows isotomous branching on the second primibrach, and has four anal plates in the dorsal cup (Schmidt 1941, p. 163). *Denariocrinus* was previously suggested as a synonym of *Decadocrinus* (Webby 1962, p. 539), but perhaps it should be retained as a separate genus, characterized by having four anal plates in the dorsal cup, while *Decadocrinus* has only two or three. *Rhadinocrinus* (type species *R. rhenanus*) differs from *Quantoxocrinus* in exhibiting forked ramules at widely spaced intervals, a radianal smaller than anal X and, proximally, a round stem (Jaekel 1895, p. 87; Schmidt 1941, p. 152). The problematical species *R. minae* (Schmidt) differs in the latter two characters, viz., a radianal smaller than anal X, and a round stem (Haarmann 1922, p. 29).

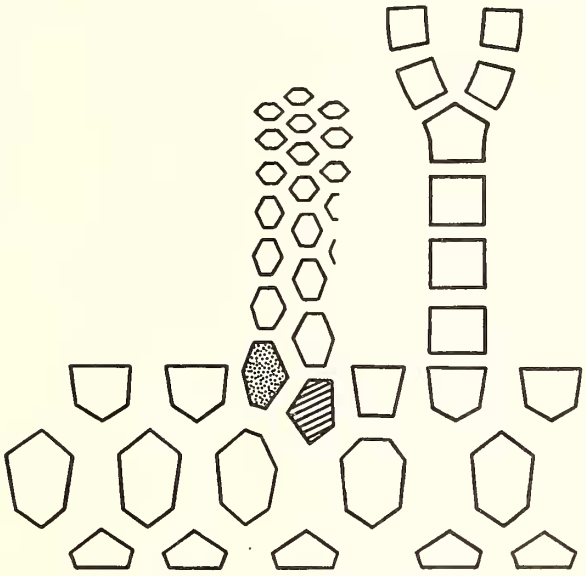
Iteacrinus, *Decadocrinus*, *Denariocrinus*, and *Rhadinocrinus* have each been classified in a different family of the Suborder Dendrocrinoidea, *Iteacrinus* being grouped in the Dendrocrinidae by Moore (1962, p. 37), *Decadocrinus* in the Scytalocrinidae by Moore and Laudon (1943, p. 59), *Denariocrinus* in the Poteriocrinitidae by Schmidt (1941, p. 163), and *Rhadinocrinus* in the Botryocrinidae by both Schmidt (1941, p. 152), and

Moore and Laudon (1943, p. 54). *Decadocrinus* and *Denariocrinus* exhibit such small differences that they should definitely be referred to the one family, and *Quantoxocrinus* should either be assigned to this family or to the Dendrocrinidae.

Quantoxocrinus ussheri sp. nov.

Plate 4; text-fig. 1

Diagnosis. A species of *Quantoxocrinus* with dorsal cup from as wide as high to a little wider than high; infrabasals prominent; basals higher than wide, depressed at sutures; radials convex, as wide as high; brachials usually as wide as high, four to five primibrachs, and pinnules, spine-like on each alternate brachial; anal sac large, erect or



TEXT-FIG. 1. Diagram showing the arrangement of plates in the dorsal cup, the proximal part of the anal sac, and the proximal part of an arm of *Quantoxocrinus ussheri* gen. et sp. nov. The radianal is shown ruled, and anal X stippled.

recurved, anal plates becoming plicated distally; proximally, the stem is composed of pentagonal columnals with slightly stellate nodals and low internodals; distally, columnals are round, with articular faces marked by radiating striae on outer edges; cirri short and tapering, borne on a few high nodals.

Description. Dorsal cup small, conical, sutures depressed, particularly between basals. Infrabasals moderately large, pentagonal, a little wider than high. Basals hexagonal, except for heptagonal posterior basal and right posterior basal; convex, higher than wide. Radials pentagonal, except for trapezoidal right posterior radial; convex, as wide as high; facets curved, extending the whole width of radial. Primibrachs four or five; quadrangular, apart from pentagonal axillary; arms long, slender and gradually tapering above the single isotomous branching; twenty-two secundibrachs in an arm length of 23 mm. above axillary of one specimen (BU 18432); brachials uniserial, smooth, convexly rounded, pinnulate, varying from as high as wide to slightly higher than wide. Pinnules on alternate brachials appearing as moderately long, spine-like projections;

pinnule segments not clearly observed. Posterior interradius with pentagonal radianal below level of the radials, slightly smaller than right posterior radial; hexagonal anal X, similar in size to the radianal; slightly smaller, hexagonal, first tube plate. Anal sac large, erect or recurved; separate rows of tube plates rest on anal X and radianal; the plates in these rows decrease uniformly in size and become slightly plicated distally; these two rows form a prominent ridge, on either side of which are depressions and secondary ridges formed by additional rows of more intensely plicated tube plates; erect anal sac observed to a height of 27 mm. (BU 18438), and others up to 5 mm. broad at the level of the main branching of arms. Proximal part of stem (at least 40 mm. in length) composed of pentagonal columnals, alternating between high, slightly stellate nodals and low internodals; distally round, with columnals including a few high, cirri-bearing nodals; articular faces of distal columnals marked by radiating striae restricted to outer edges, and forming a crenulate suture; axial canal circular; cirri rather short and sharply tapered, up to 15 mm. long; composed of numerous, thin disc-like segments similar to distal columnals but smaller.

Dimensions (mm.)

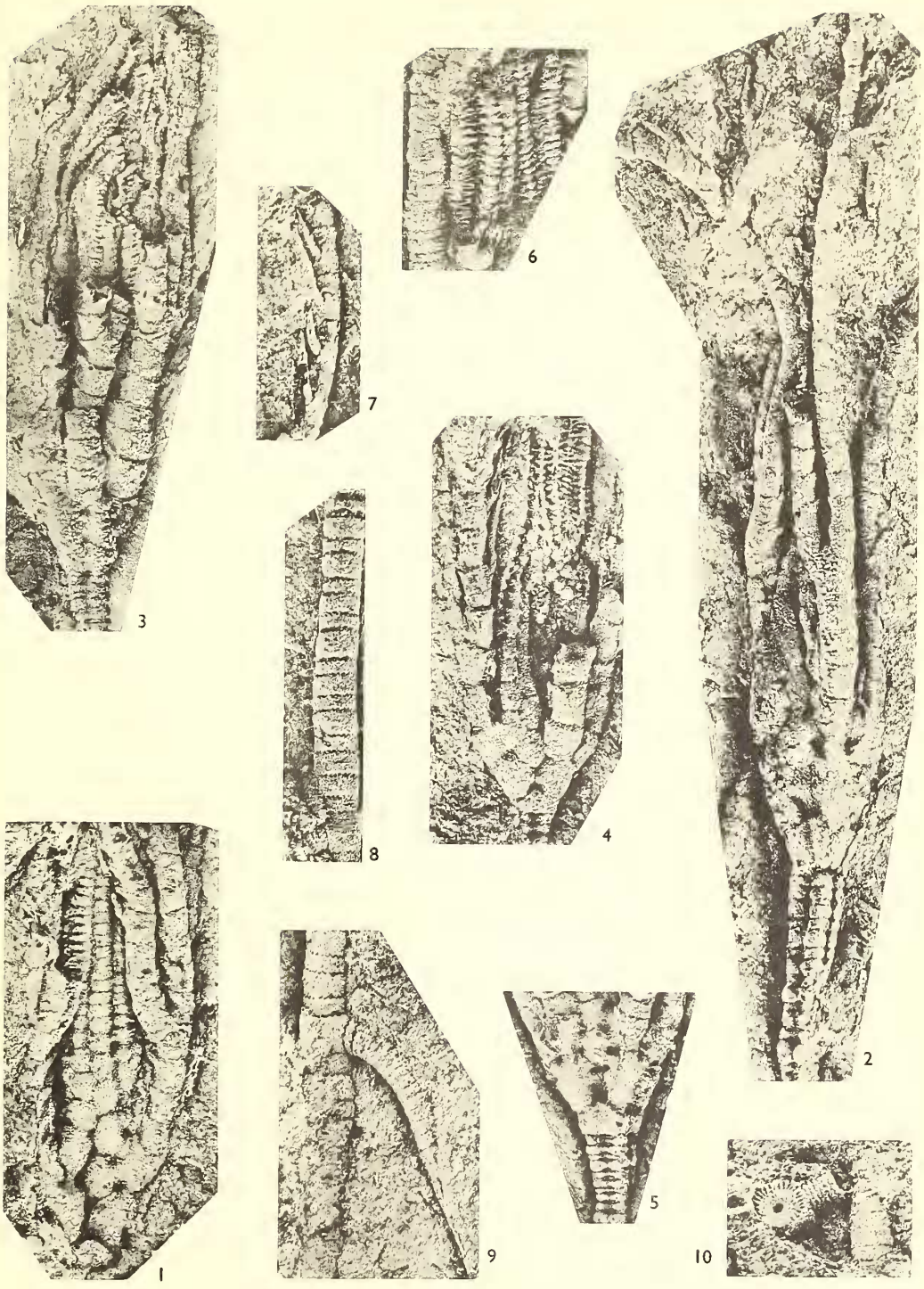
	Holotype BU 18431	*BU 18432*	*BU 18433*	*BU 18434*	*BU 18435*	*BU 18436*	*BU 18437*
Hc .	5·5	7·6*	5·0	4·3	5·1	4·2	5·9
Hb .	2·6	2·2	2·1	2·1	2·2	2·1	2·8
Hib .	1·4	1·9	1·5	1·3	1·5	1·3	1·8
Wcr .	5·8	5·2	5·1	5·3	6·2	6·0	+4·5
Wcb .	2·0	2·0	1·9	1·8	2·0	1·9	1·9

Hc, height of dorsal cup; *Hb*, average height of basals; *Hib*, average height of infrabasals; *Wcr*, width of dorsal cup at the level of the radial facets; *Wcb*, width of dorsal cup at base of cup; *, distorted dorsal cup.

EXPLANATION OF PLATE 4

All figures ×3·5; from latex (Revultex) casts of external moulds.

Figs. 1–10. *Quantoxocrinus ussheri* gen. et sp. nov. 1, Holotype, BU 18431, posterior view, showing arrangement of plates in the posterior interradius, the proximal part of the anal sac, and the isotomous branching of an arm on the fourth primibrach. The anal sac is broad and apparently erect, composed of several rows of plates, gradually diminishing in size distally. 2, Paratype, BU 18432, right postero-lateral view, showing proximal part of stem, composed of stellate columnals, elongated (probably tectonically distorted), poorly preserved dorsal cup, and long, slender arms, branching isotomously on the fourth primibrach. 3, Paratype, BU 18433, right lateral view, showing comparatively large infrabasal, basals, and radials, and isotomous branching on the fifth primibrach. 4, Paratype, BU 18434, posterior view, showing arrangement of plates in the dorsal cup, with a moderately large infrabasal, gently convex basals and radials, and a radianal similar in size to anal X; anal sac recurved and distally plicated. Primibrachs of left posterior arm appear to be slightly distorted; they exhibit long, slender pinnules. 5, Paratype, BU 18435, right postero-lateral view, showing stem with alternating high, stellate nodals and low internodals, large infrabasals, basals with depressed sutures, radials, and plates of the posterior interradius. 6, Paratype, BU 18452, view of a portion of a plicated anal sac, and the distal part of the stem of another specimen. 7, Paratype, BU 18454, view of moderately long, spine-like pinnules, occurring on alternate secundibrachs. 8, Paratype, BU 18459, view of distal part of stem with round columnals of irregular height, and crenulated sutures. 9, Paratype, BU 18453, view of distal part of stem, showing a high nodal which bears a short, tapering cirrus. 10, Paratype, BU 18451, view of distal stem columnals, showing the articular face of a cirrus-bearing nodal with radial striae restricted to the outer edge, and a circular axial canal.



WEBBY, Devonian inadunate crinoid